TX 90 Kinematics
The useful way to have a model into Kautham 2.0

Alexander Pérez*and Jan Rosell
Technical University of Catalonia

October, 2008

Abstract

This file contains a short description about the way to be created a Staübli TX90 robot model in order to be used into the Kautham 2.0 planner from the Institute of Industrial and Control Engineering (IOC).

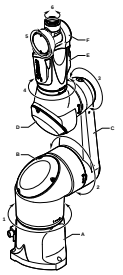

Figure 1: TX90 axis and DOF.

1 Introduction

Using the Staübli information about their own TX90 robot, we has been build a model using each link and describing its position and orientation through Denavit – Hartenberg parameters. We provide models for every link and an XML structured file that describes all information about how to the robots is armed.

2 Robot description

The TX90 is an articulated industrial robot. The Fig. 1 shows the robot in the initial configuration (home) and its six degree of freedom (DOF).

The table 1 shows the Hi and Low limits for each joint in the robot.

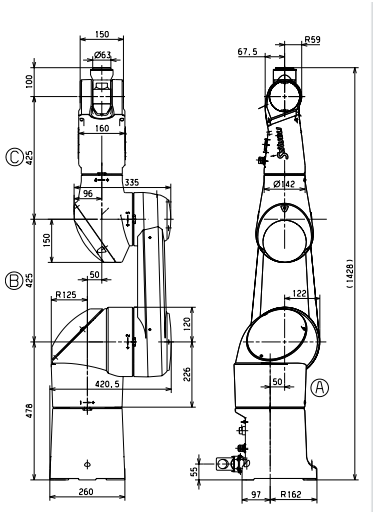

Figure 2: TX90 dimensions.

*Is also with the Escuela Colombiana de Ingeniería "Julio Garavito", Bogotá D.C.

Motion Range	Axis 1 (A)	± 180°
	Axis 2 (B)	+147,5°/-130°
	Axis 3 (C)	± 145°
	Axis 4 (D)	± 270°
	Axis 5 (E)	+140°/-115°
	Axis 6 (F)	± 270°

Table 1: Articulation limits

3 Link models and attached frames

Following the D-H method, each link have their own attached frame. The Fig. 3 shows the robot totally assembled and the postition and orientation for each frame. The following figures numbered as 4, 5, 6, 7, 8, 9, 10, show the respective attached fixed frame for each link.

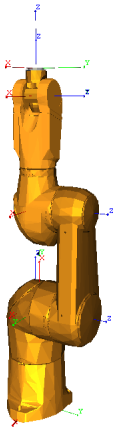

Figure 3: TX90 Model with attached frames in each link corresponding to D-H description.

4 Denavit – Hartember parameters

The D–H method has two well defined approaches in order to describe the transformation between two frames. The Standard approach use the sequence

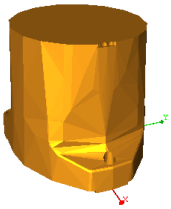

Figure 4: Static part: the base.

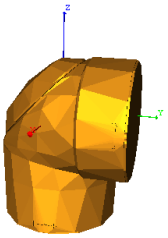

Figure 5: First link: the shoulder

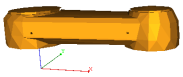

Figure 6: Second link: the forearm

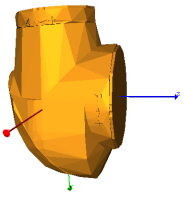

Figure 7: Third link: the elbow

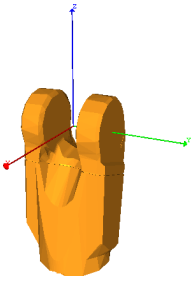

Figure 8: Fourth link: the arm

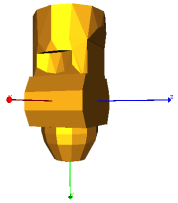

Figure 9: Fifth link: the wirst

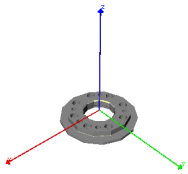

Figure 10: Sixth link: the TCP

$R_{(z,\theta)}T_{(z,d)}T_{(x,a)}R_{(x,\alpha)}$ and the Modified approach use this $R_{(x,\alpha)}T_{(x,a)}R_{(z,\theta)}T_{(z,d)}$. Each one has the particularities in the way to chose the origins of the each coordinates frame. For this moment, we only use the Modified approach in order to describe the Kinematics of the TX90 robot.

This robots has all joints as rotational and in the D–H point of view, the only one variable values to reach any configuration are the θ parameters. The table 2 shows the D-H values in order to have the home pose.

Link	α	a	θ	d
Shoulder	0	0	0	478
ForeArm	-90	50	-90	50
Elbow	0	425	90	0
Arm	90	0	0	425
Wrist	-90	0	0	0
TCP	90	0	0	100

Table 2: Constructive parameters (angles in degrees and distances in mm

.

5 XML structured file – ROB

The XML file describes how to build the robot using each link and in which order has been used.

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<Robot name="Staubli_TX90">
  Robot description name.

  <Join name="Base" ivFile="rtx90/base.wrl">
    <DHPars alpha="0.0" a="0.0" theta="0.0" d="0.0"></DHPars>
    <Description rotational="false" movable="false" ></Description>
    <Limits Hi="0" Low="0"></Limits>
  </Join>

  <Join name="Shoulder" ivFile="rtx90/shoulder.wrl">
    <DHPars alpha="0.0" a="0.0" theta="-90.0" d="478.0" ></DHPars>
    <Description rotational="true" movable="true" ></Description>
    <Limits Hi="180.0" Low="-180.0"></Limits>
  </Join>

  <Join name="ForeArm" ivFile="rtx90/forearm.wrl">
    <DHPars alpha="-90.0" a="50.0" theta="-90.0" d="50.0"></DHPars>
    <Description rotational="true" movable="true" ></Description>
    <Limits Hi="180.0" Low="-180.0"></Limits>
  </Join>

  <Join name="Elbow" ivFile="rtx90/elbow.wrl">
    <DHPars alpha="0.0" a="425.0" theta="90.0" d="0.0"></DHPars>
    <Description rotational="true" movable="true" ></Description>
    <Limits Hi="180.0" Low="-180.0"></Limits>
  </Join>

  <Join name="Arm" ivFile="rtx90/arm.wrl">
    <DHPars alpha="90.0" a="0.0" theta="0.0" d="425.0"></DHPars>
    <Description rotational="true" movable="true" ></Description>
    <Limits Hi="180.0" Low="-180.0"></Limits>
  </Join>

  <Join name="Wrist" ivFile="rtx90/wrist.wrl">
    <DHPars alpha="-90.0" a="0.0" theta="0.0" d="0.0"></DHPars>
    <Description rotational="true" movable="true" ></Description>
    <Limits Hi="180.0" Low="-180.0"></Limits>
  </Join>

  <Join name="Tcp" ivFile="rtx90/tcp.wrl">
    <DHPars alpha="90.0" a="0.0" theta="0.0" d="100.0"></DHPars>
    <Description rotational="true" movable="true" ></Description>
    <Limits Hi="180.0" Low="-180.0"></Limits>
  </Join>

</Robot>
```

Figure 11: XML file defining the robot links and their parameters.